TENTATIVE

SANYO TECHNICAL DATA

LIQUID CRYSTAL DOT MATRIX DISPLAY MODULE

LCM-567-31 **（16×1 Line）

- A : Reflective
- HA : Transflective(posi)
- NA : Itransparent (nega)

* Super Twist 35 Nematic

Jun. 3 , 1987

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FEATURES

1) Control LSI built in.
2) 5 × 7 dot matrix with cursor.
3) Microprocessor compatible data bus interface (8-bit
4) Character generator ROM built in
   5 × 7 font : Alphanumeric ------ 96 characters
   Japanese ---------- 64 characters
5) Character Generator RAM ---------- (Customer Specified)
   5 × 7 font : 8 characters
6) Powerful control commands
   ① Display clear
   ② Return home
   ③ Cursor preset.
   ④ Cursor ON/OFF or Character blinking
   ⑤ Cursor shift.
   ⑥ Display shift.
   ⑦ Display ON/OFF
   ⑧ Display data read/write
7) ±5 volts power supply (Without EL power supply)
8) Low power consumption.
9) Light weight and extremely compact size
10) EL Back Light Option.

   A Reflective Type (Without EL/Pos)
   NA Transflective Type with EL/Pos)
   NA Transparent Type with EL/Neg)

Liquid Crystal Dot Matrix Module

SANYO Dot Matrix Module LCM-567-31**(16 Characters × 1 Line)consists of STN LC display, C-MOS driver, C-MOS LSI to control and EL for back light. The module utilize 5×7 dot matrix characters to provide full alphanumeric capability. All control, refresh and display functions are executed by a dedicated on-board controller.
The module is capable of displaying the full 160-character JIS font set. Data interfacing is via an 8-bit bi-directional data bus or a 4-bit one. By use of simple control commands, data can be selectively written to (or read from) any cursor location, arbitrary fonts can be written to CHARACTER GENERATOR RAM.

1. FEATURES

1) Control LSI built in.
2) 5 × 7 dot matrix with cursor.
3) Microprocessor compatible data bus interface (8-bit or 4-bit).
4) Character generator ROM built in.
   5 × 7 font : Alphanumeric ---- 96 characters
   Japanese ------- 64 characters
5) Character generator RAM ------- Customer rewritable
   5 × 7 font : 8 characters
6) Powerful control commands
   ① Display clear
   ② Return home
   ③ Cursor preset
   ④ Cursor ON/OFF or Character blinking
   ⑤ Cursor shift
   ⑥ Display shift
   ⑦ Display ON/OFF
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7) ±5 volts power supply. (without EL power supply)
8) Low power consumption.
9) Light weight and extremely compact size
10) EL Back Light Option
   A : Reflective Type without EL(Posi)
   HA : Transflective Type with EL(Posi) EL Color:blue green
   NA : Transparent Type with EL(Nega) EL Color:blue green

2. ABSOLUTE MAXIMUM RATINGS

V_{SS}=0V, Ta=25°C

Item	Symbol	Min.	Max.	Unit
Logic circuit Power supply voltage	$V_{DD}-V_{SS}$	0	7.0	V
LC driver circuit supply voltage	$V_{DD}-V_o$	0	13.5	V
Input voltage	V_I	V_{SS}	V_{DD}	V
Operating temp.	T_{OP}	0	50	°C
Storage temp.	T_{STG}	−20(100hr)	70(100hr)	°C

3. ELECTRICAL CHARACTERISTICS

V_{DD}=5.0±0.25V, Ta=25°C

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input "High" Voltage	V_{IH}		2.2	—	V_{DD}	V
Input "Low" Voltage	V_{IL}		—	—	0.6	V
Output "High" Voltage	V_{OH}	$-I_{OH}$=0.205mA	2.4	—	—	V
Output "Low" Voltage	V_{OL}	I_{OL}=1.2mA	—	—	0.4	V
Power Supply Current	I_{DD}	V_{DD}=5.0V	—	1.0	2.0	mA
Power Supply Voltage for LCD (Recommended) (1/16 duty)	$V_{DD}-V_o$	Top=0°C	8.6	8.7	8.8	V
		Top=25°C	8.1	8.2	8.3	V
		Top=50°C	7.3	7.4	7.5	V

4. TIMING CHARACTERISTICS

4-1. Write Operation

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Enable cycle time	tcyc E	Fig. 1	1.0	–	–	μs
Enable pulse width	PWEH	Fig. 1	450	–	–	ns
Enable rise & fall time	tEr, t Ef	Fig. 1	–	–	25	ns
Address set-up time	t AS	Fig. 1	140	–	–	ns
Address hold time	t AH	Fig. 1	10	–	–	ns
Data set-up time	t DSW	Fig. 1	195	–	–	ns
Data hold time	t H	Fig. 1	10	–	–	ns

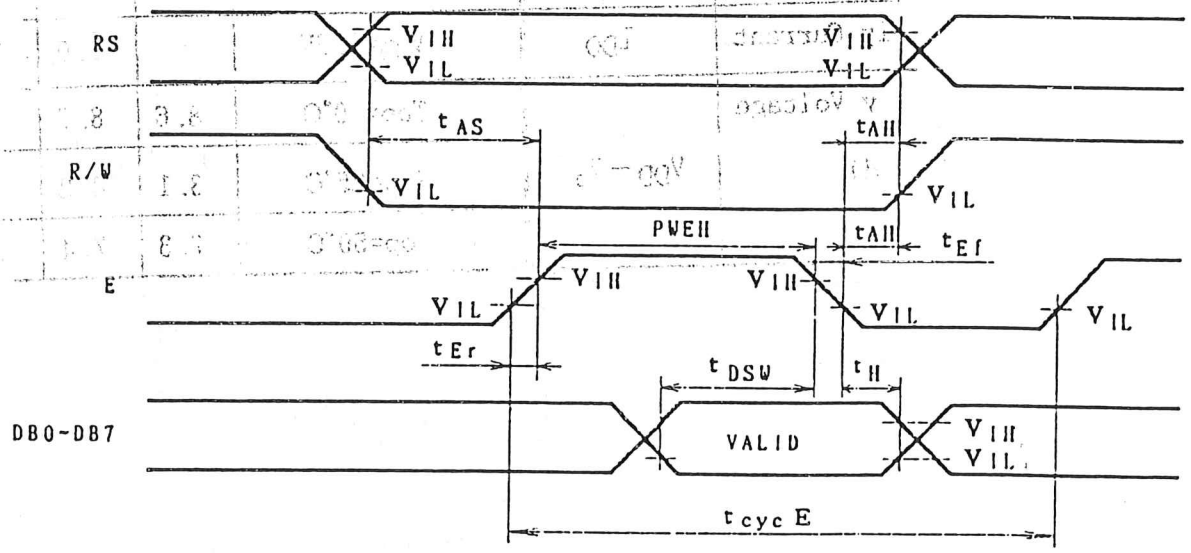


Fig. 1 Writing Data (from MPU to Module)

4-2. Read Operation

Item	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Enable cycle time	tcyc E	Fig. 2	1.0	–	–	μs
Enable pulse width	PWEH	Fig. 2	450	–	–	ns
Enable rise & fall time	tEr, t Ef	Fig. 2	–	–	25	ns
Address set-up time	t AS	Fig. 2	140	–	–	ns
Address hold time	t AH	Fig. 2	10	–	–	ns
Data delay time	t DDR	Fig. 2	–	–	320	ns
Data hold time	t DHR	Fig. 2	20	–	–	ns

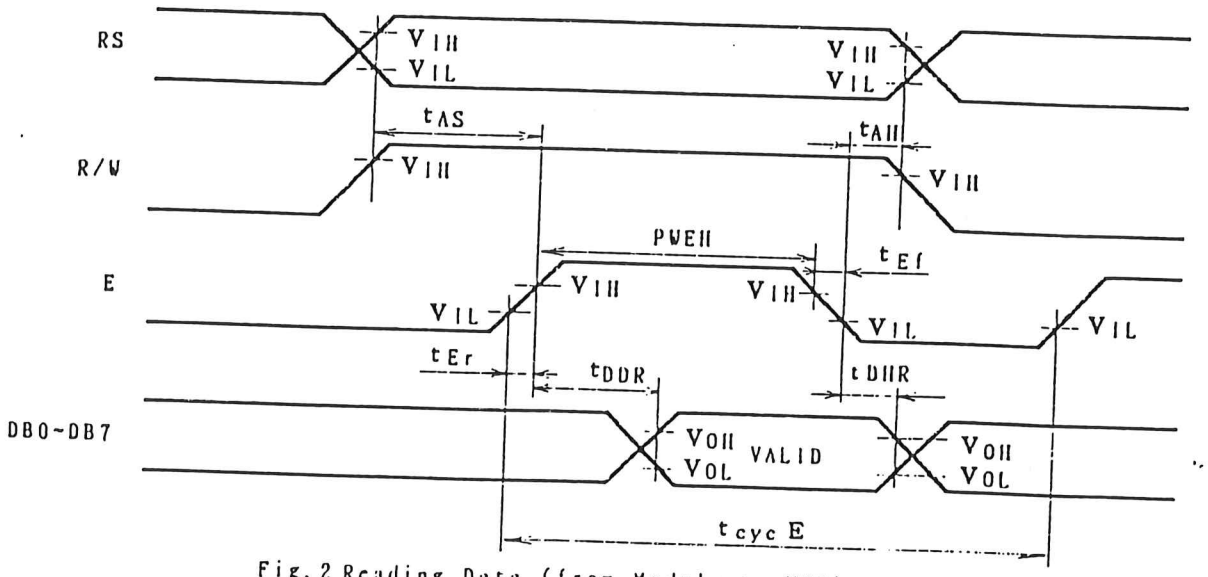


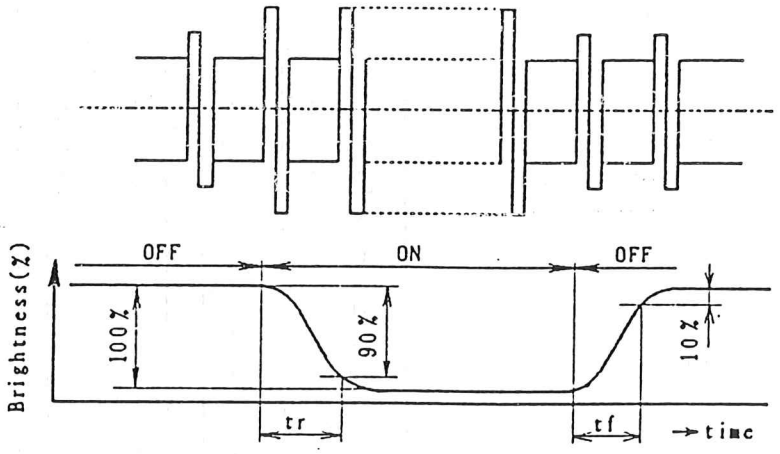
Fig. 2 Reading Data (from Module to MPU)

5. OPTICAL CHARACTERISTICS

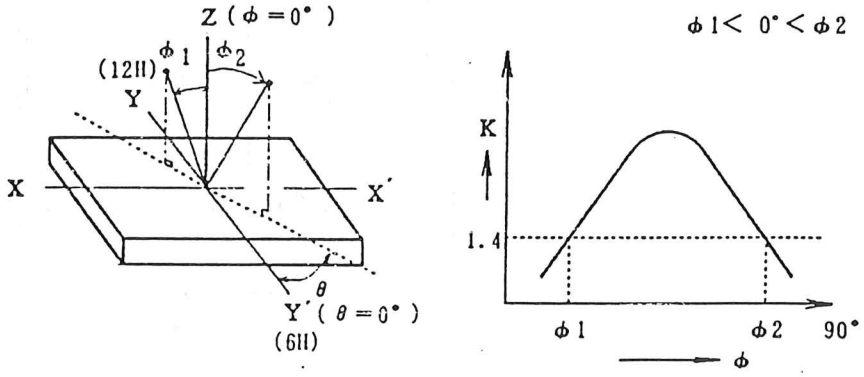
Reflective type Viewing angle 6H $V_{DD}-V_O$=8.2V, Ta=25°C

Item	Sym.	Condition	Min.	Typ.	Max.	Unit	Ref.
Rise time	tr	ϕ=20° θ=0°	—	150	250	ms	Note 1)
Fall time	tf	ϕ=20° θ=0°	—	150	250	ms	Note 1)
Contrast	K	ϕ=20° θ=0°	3	—	—	—	Note 3)
View area	ϕ1～ϕ2	θ=0° K=1.4	40	—	—	DEG.	Note 2)
	θ	ϕ=20° K>1.4	±30	—	—	DEG.	Note 2)

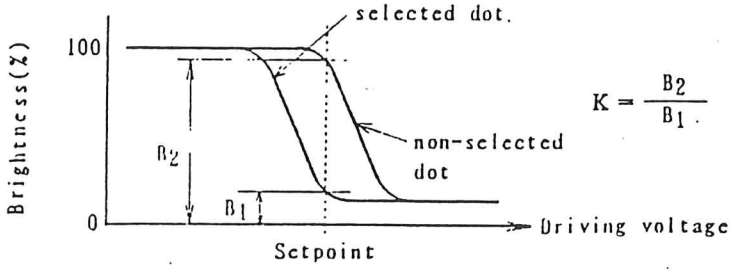
Note 1) Definition of optical response



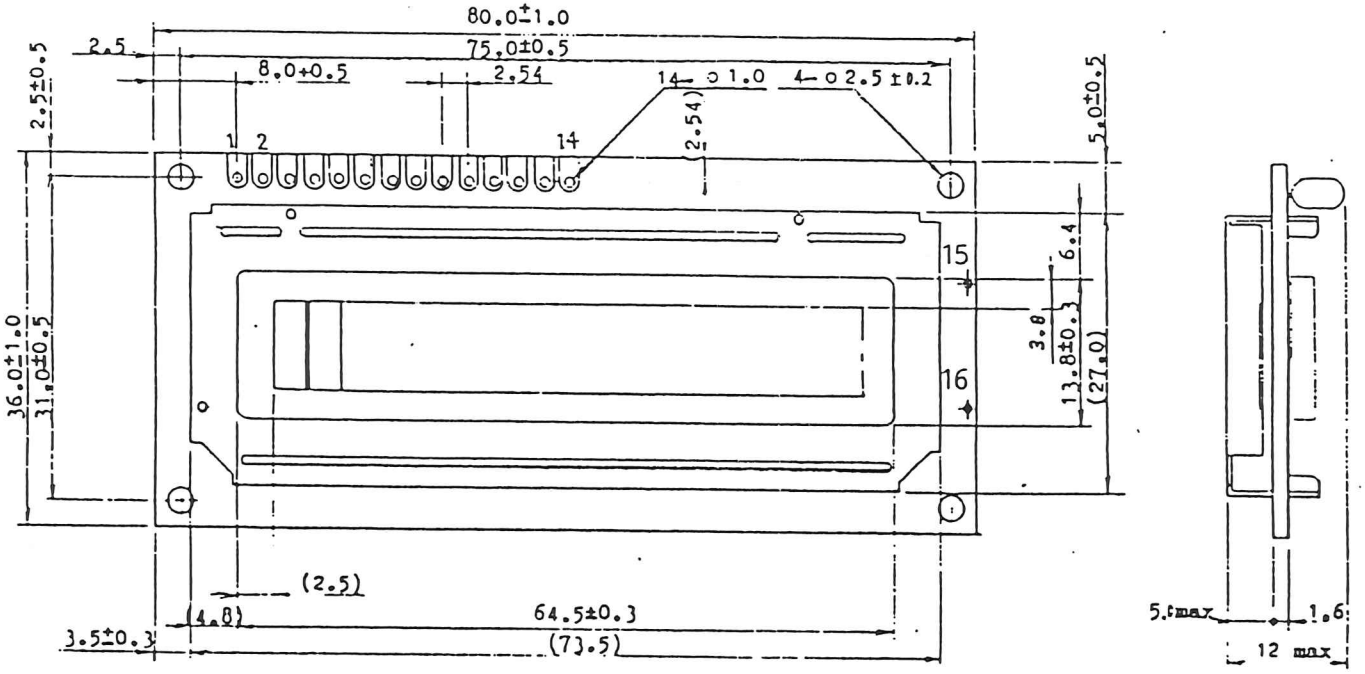
Note 2) Definition of angle θ and ϕ



Note 3) Definition of contrast 'K'

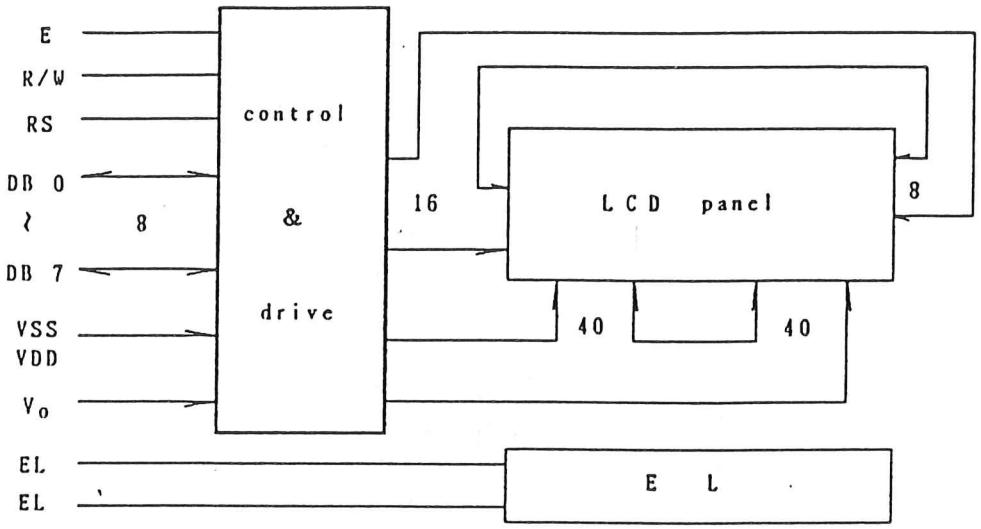


6. DIMENSIONS



Unit : mm

7. BLOCK DIADRAM

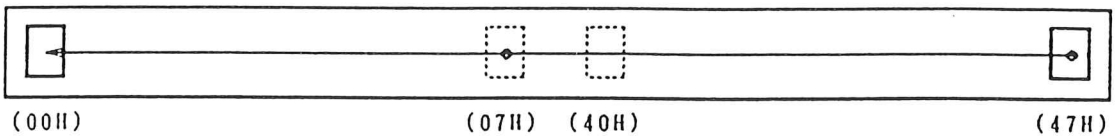


8. PIN CONNECTION

Pin No.	Signal	Pin No.	Signal
1	V_{SS}	9	DB 2
2	V_{DD}	10	DB 3
3	V_o	11	DB 4
4	RS	12	DB 5
5	R/W	13	DB 6
6	E	14	DB 7
7	DB 0	15	EL
8	DB 1	16	EL

9. RETURN HOME

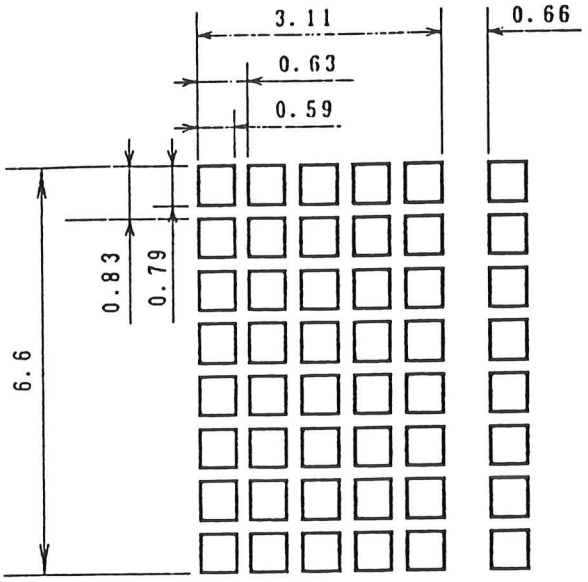
After execution



Before execution

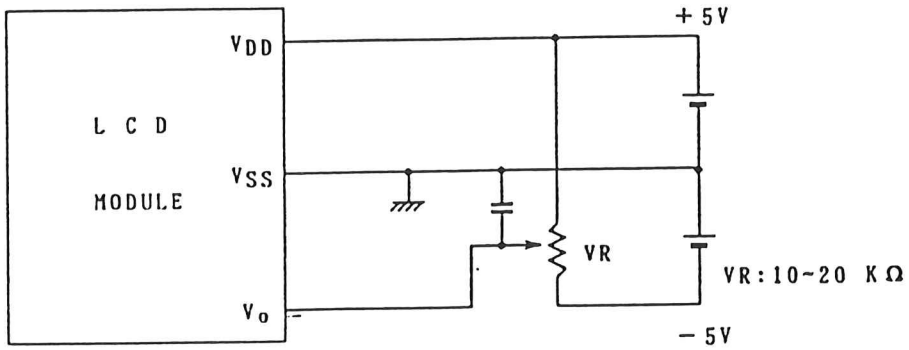
Cursor returns to home position (00H) by executiog "RETURN HOME" command.

10. DISPLAY PATTERN



UNIT : mm

11. POWER SUPPLY



12. PIN FUNCTION

Pin Name	I/O	Function
V_{SS}		GND : 0V
V_{DD}		+5V
V_O		Power supply for LC driving
RS	I	Signal to select registers "0" : Instruction register (for write) : Busy flag , address counter (for read) "1" : Data register (for read and write)
EL		Drive voltage for EL (electro luminescent lamp) AC 100V (RMS) 400Hz type
R/W	I	Signal to select read (R) or write (W) "0" : write MPU → LCD Module "1" : read MPU ← LCD Module
E	I	Signal to enable read and write of each LSI data (Active H)
DB 0 ∫ DB 3	I/O	Data bus of lower order 4 lines having bidirectional port. Used for data transfer between the MPU and the module. These four are not used during 4 bits operating.
DB 4 ∫ DB 7		Data bus of higher order 4 lines having bidirectional port. Used for data transfer between the MPU and the module. DB7 can be used as a BUSY FLAG.

NOTE : In the module, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

(1) When interface data is 4 bits long, data is transferred using only 4 buses of DB4 ~ DB7. DB0 ~ DB3 are not used. Data transfer between the module and the MPU complete when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of DB4 ~ DB7 when interface data is 8 bit long) is transferred first and lower order 4 bits (contents of DB0 ~ DB3 when interface data is 8 bits long).

(2) When interface data is 8 bits long, data is transferred using 8 data buses of DB0 ~ DB7.

13. TABLE INSTRUCTIONS

Instruction	Code										Description	Execution time (When fosc is 250KHz)
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear display	0	0	0	0	0	0	0	0	0	1	Clears all display and returns the cursor to the home position (Address 0)	82μs ~ 1.64ms
Return home	0	0	0	0	0	0	0	0	1	*	Return the cursor to the home position (Address 0). Also returns the display being shifted to the original position. DD RAM contents remain unchanged.	40μs ~ 1.6ms
Entry mode set	0	0	0	0	0	0	0	1	I/D	S	Sets the cursor move direction and specifies or not to shift the display. There operation are performed during data write and read.	40μs
Display ON/OFF ontrol	0	0	0	0	0	0	1	D	C	B	Sets ON/OFF of all display (D) cursor ON/OFF (C), and blink of cursor position character (B).	40μs
Cursor or display shift	0	0	0	0	0	1	S/C	R/L	*	*	Moves the cursor and shifts the display without changing DD RAM contents.	40μs
Function set	0	0	0	0	1	DL	N	F	*	*	Sets interface data length (DL) number of display lines (L) and character font (F).	40μs
Set CG RAM address	0	0	0	1	ACG						Sets the CG RAM address CG RAM data is sent and received after this setting.	40μs
Set DD RAM address	0	0	1	ADD							Sets the DD RAM address DD RAM data is sent and received after this setting.	40μs
Read busy flag & address	0	1	BF	AC							Reads Busy flag (BF) indicating internal operation is being performed and reads address counter contents.	1μs
Write data to CG or DD RAM	1	0	Write Data								Writes data into DD RAM or CG RAM.	40μs
Read data from CG or DD RAM	1	1	Read Data								Reads data from DD RAM or CG RAM.	40μs
	I/D = 1 : Increment I/D = 0 : Decrement S = 1 : Accompanies display shift. S/C = 1 : Display shift S/C = 0 : Cursor move R/L = 1 : Shift to the right. R/L = 0 : Shift to the left. DL = 1 : 8 bits, DL = 0 : 4 bits N = 1 : 2 lines, N = 0 : 1 line F = 1 : 5X10 dots, F = 0 : 5X7 dots BF = 1 : Internally operation BF = 0 : Can accept instruction D = 0 : Display OFF D = 1 : Display ON C = 0 : Cursor OFF C = 1 : Cursor ON B = 0 : Blink OFF B = 1 : Blink ON											DD RAM : Display data RAM CG RAM : Character generator RAM ACG : CG RAM address ADD : DD RAM address Corresponds to cursor address. AC : Address counter used for both of DD and CG RAM address.	Execution time changes when frequency changes. (Example) When fosc is 270KHz. $40\mu s \times \frac{250}{270} = 37\mu s$

* Don't care

14. RESET FUNCTION

The module automatically performs initialization (reset) when power is turned on (using internal reset circuit). The following instructions are executed in initialization.

(1) Clear display

The BUSY FLAG is kept in the busy state (BF=1) until initialization ends. The time is 15ms.

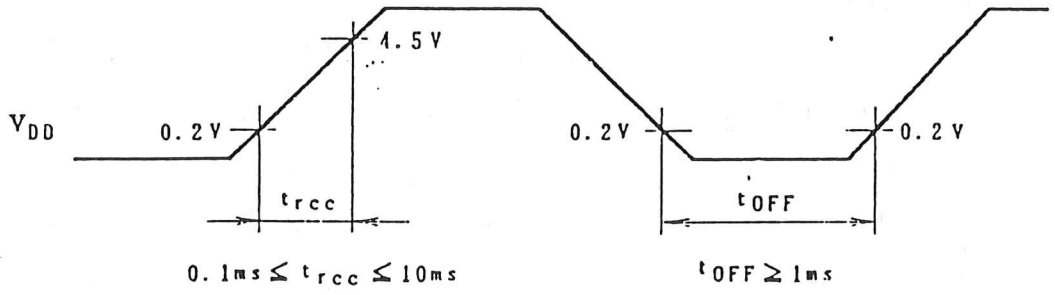
(2) Function set ·····DL=1 : 8 bits long interface data
N=0 : 1-line display
F=0 : 5×7 dot character font

(3) Display ON/OFF control·····D=0 : Display OFF
C=0 : Cursor OFF
B=0 : Blink OFF

(4) Entry mode set·····I/D=1: +1 (increment)
S=0 : No shift

(5) DD RAM selected

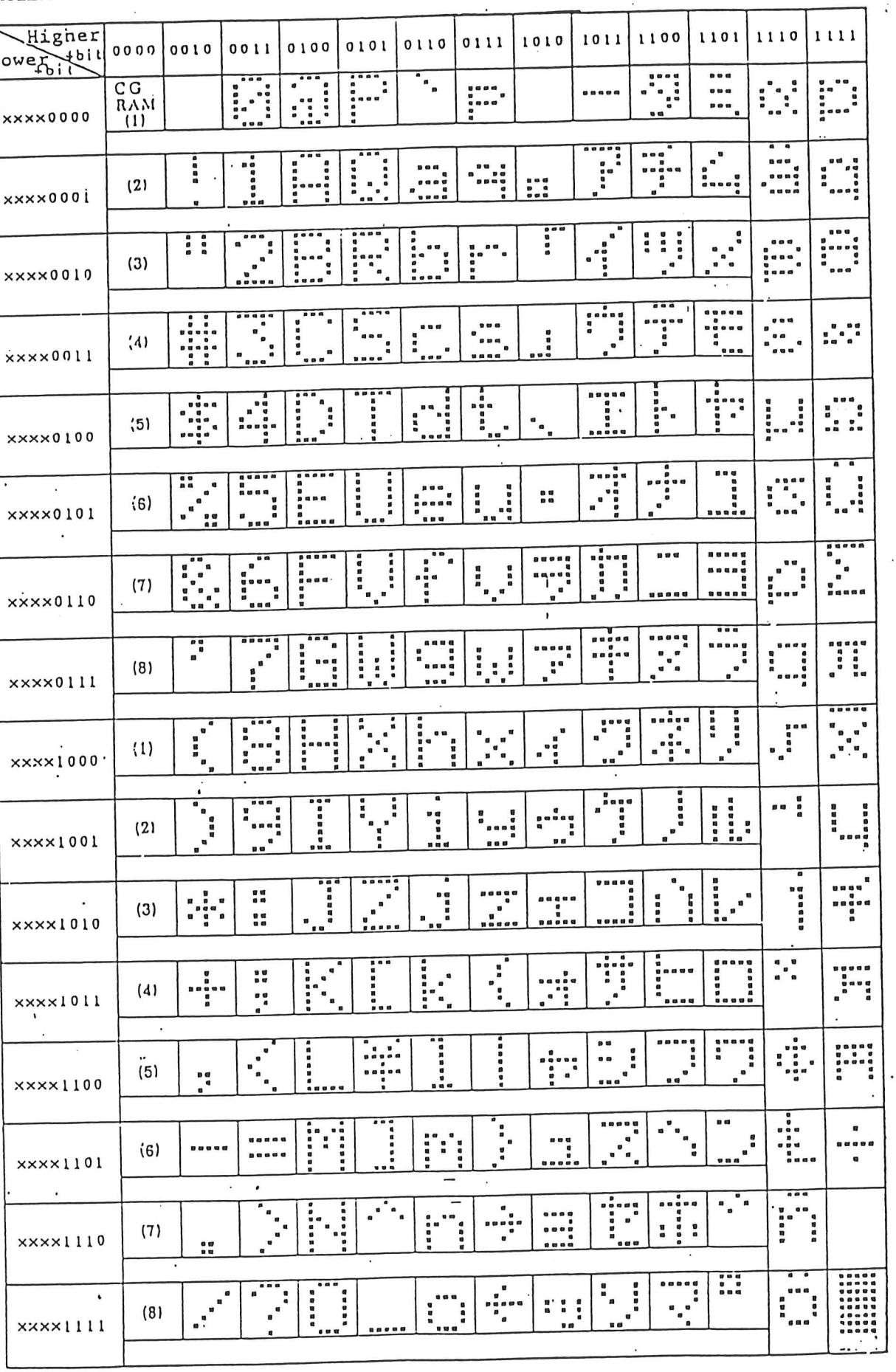
Because initialization may not be performed completely depending on the rise time of the power supply when it is turned on, pay attention to the following time relationship.



t_{OFF} stipulates the time of power OFF for power supply instantaneous dip or when power supply repeats ON and OFF.

NOTE : When the above power supply condition is not satisfied, the internal reset circuit does not operate normally.

CHARACTER PATTERN



■ PRECAUTION FOR USING

1. Handling
   (1) Do not touch, press, or rub the display panel with a hard tool or object such as tweezers as the polarizers in the panel are easily scratched.
   (2) Do not use organic solvents to clean the display panel off as these solvents may be adverse to polarizer. To clean the surface off, dried cloth, dampened absorbent cotton with petroleum benzine or adhesive tape are preferable.
   (3) Do not touch electrode terminals of p.c.board or LSI leads.
   (4) Avoid using or storing the module under the conditions of high temperature and high humidity.
   When stored, this module should be packaged in a conductive polyethylene bag and placed under the certain condition where the temperature is relatively low (5 - 30°C). The direct sunlight or fluoresent lamp must be shut off.

2. Operating
   (1) Do not connect or disconnect the Module to or from main system while power is being supplied.
   (2) Use the module within specified temperature: otherwise it causes the retardation of blinking speed of the display below specified temperature and causes the display to get dark above specified temperature.
   (3) Adjust the LC driving voltage (Vo) so that the display shows optimum contrast.

3. Men working
   (1) Use a grounded soldering iron when connecter terminals are soldered.
   (2) Do not disassemble. In case that, after disassembling, the module doesn't work due to failure of reassembly, it is not our resposibility.
   (3) In case that the molule is shipped without EL and customers use the module inserting EL afterward, it is not our responsibility for any troubles occurred in relation to such insertion.
   (4) Care should be taken not to charge static electricity, as the circuit of this module contains CMOS LSIs. A workman's body should be grounded with an earth-band. The material which prevents static electricity should be selected for a working cloth.

APPEARANCE LIMITATION (L C D)

Regulation of the following items that appear in the effective display area

(1) Black spots, foreign articles, pinhole, white spots

Dimension D (mm)	Numbers
D ≤ 0.15	No Count
0.15 < D ≤ 0.20	N≤ 2
0.20 < D	N= 0

(2) White line, black line, scratch

Width W (mm)	Length L (mm)	Numbers
W ≤ 0.03	L ≤ 0.5	No Count
0.03 < W ≤ 0.05	0.5 < L ≤ 2.0	N ≤ 3
0.05 < W	2.0 < L	N = 0

(3) Bubbles of polarizer

Diameter D (mm)	Numbers
D ≤ 0.5	No Count
0.5 < D ≤ 1.0	N ≤ 3
1.0 < D	N = 0

(4) Line, scratch of polarizer

Width W (mm)	Length L (mm)	Numbers
W ≤ 0.3	——	No Count
0.3 < W ≤ 1.0	L ≤ 5.0 5.0 < L ≤ 10.0 10.0 < L	No Count N ≤ 2 N = 0
1.0 < W	——	N = 0

(5) Bruise of both sides of polarizer

No more than 2 pcs. (D ≤ 0.3)

(6) Uneven color

Close to uniformity. (See specimen)